Luminous Quasars Do Not Live in Overdense Regions of LBGs at z~4

Hisakazu Uchiyama

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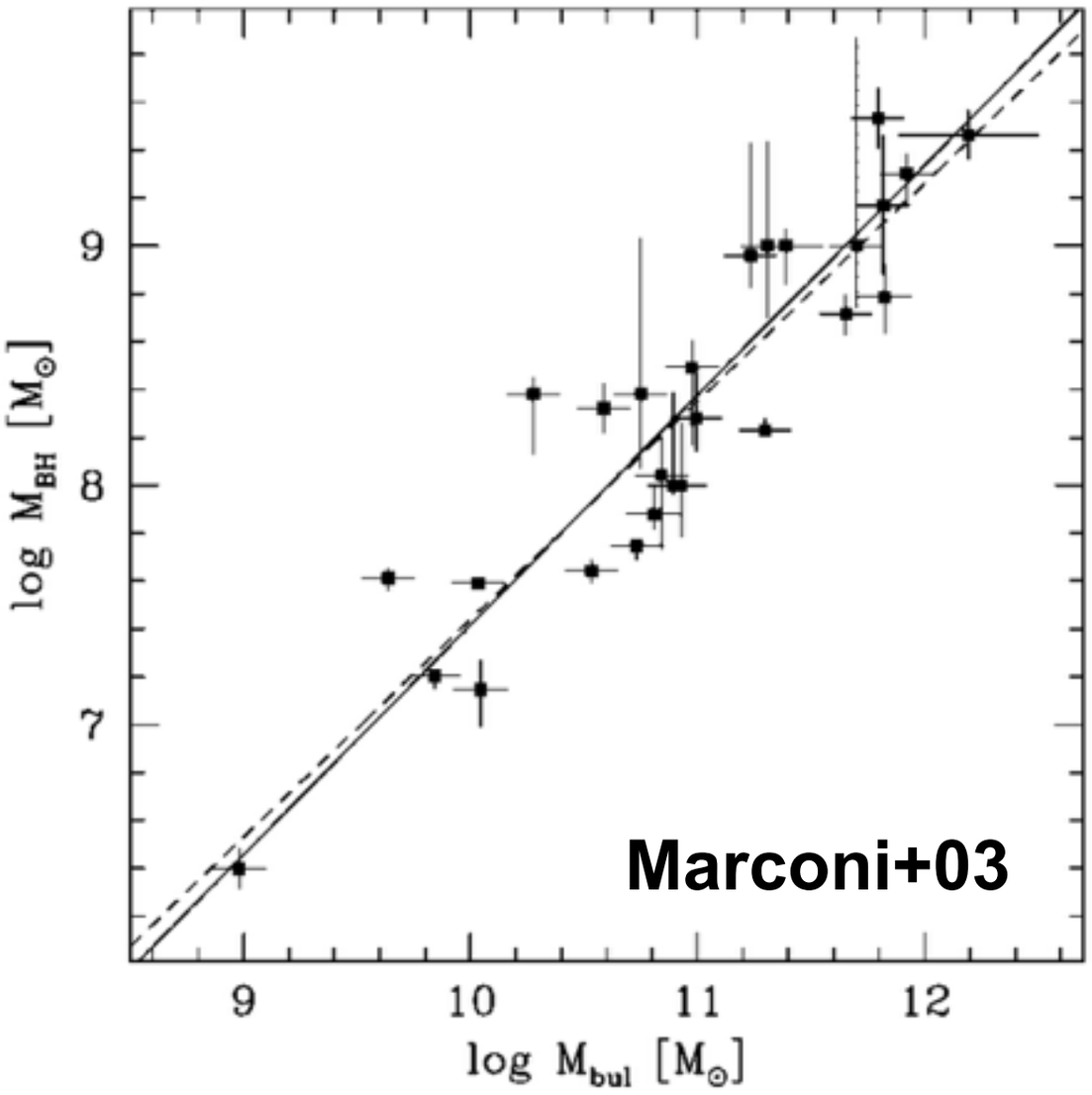
Uchiyama et al. (2017) arXiv : 1704.06050
Onoue et al. (2017) arXiv : 1704.06051

Background

M-σ relation



Merger scenario

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→ QSOs are expected to appear in
massive halo, galaxy overdense region, protocluster

→ QSOs are signposts for high-z protoclusters

Previous studies about QSO environment at z>3

authour	z	galaxy	#overdense regions/#total
Adams+15	~4	LAE/LBG	1/9
Kikuta+17	4.9	LAE	0/2
Banados+13	5.72	LAE	0/1
Mazzucchelli+17	5.73	LAE	0/1
Husband+13	~5	LBG	3/3
Morselli+14	~6	LBG	4/4
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→ QSO is rare ; volume density is very low
protocluster is very rare ; only~10 at z >3 (Chiang+13)

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different depth and area, and different definitions of overdensity

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[illegible]	[illegible]	[illegible]	[illegible]

Hyper Suprime-Cam (HSC) : Wide and Deep imaging survey

statistically characterize whether protoclusters host QSOs at z~4 by searching for overdense regions of g-dropouts

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Protocluster and QSO sample

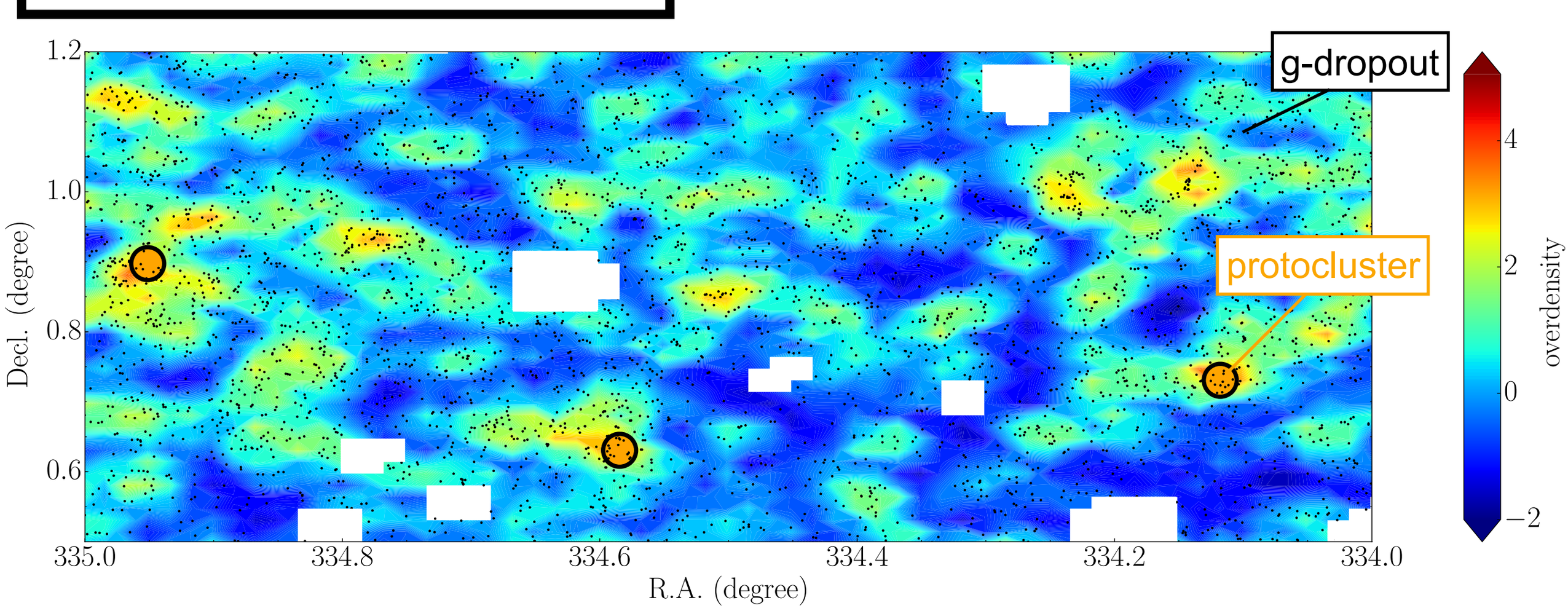
Protocluster

HSC-SSP Wide S16A DR

~121 deg^2

>4σ g-dropout overdense reg.

179 protocluster candidates



Protocluster and QSO sample

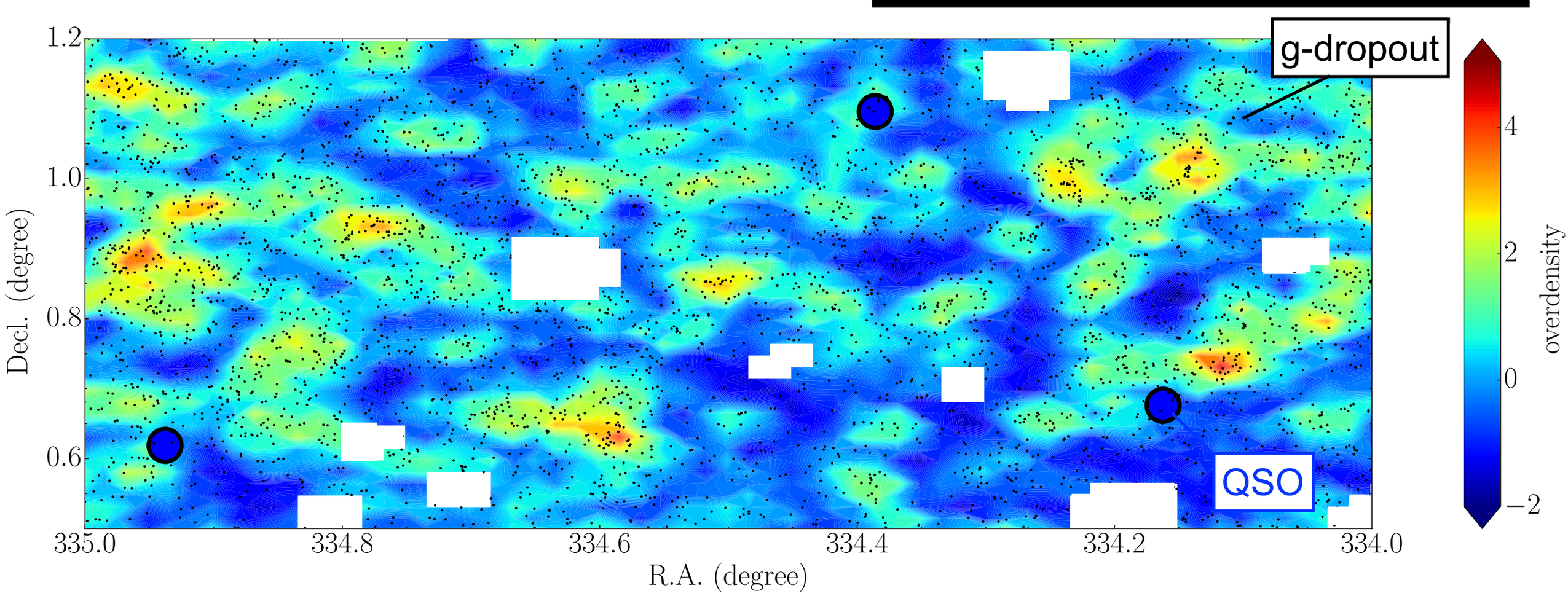
QSO

SDSSDR12 QSO (DR12Q)

~121 deg^2

151 QSOs at z=3.3-4.2

M_{UV} < -26



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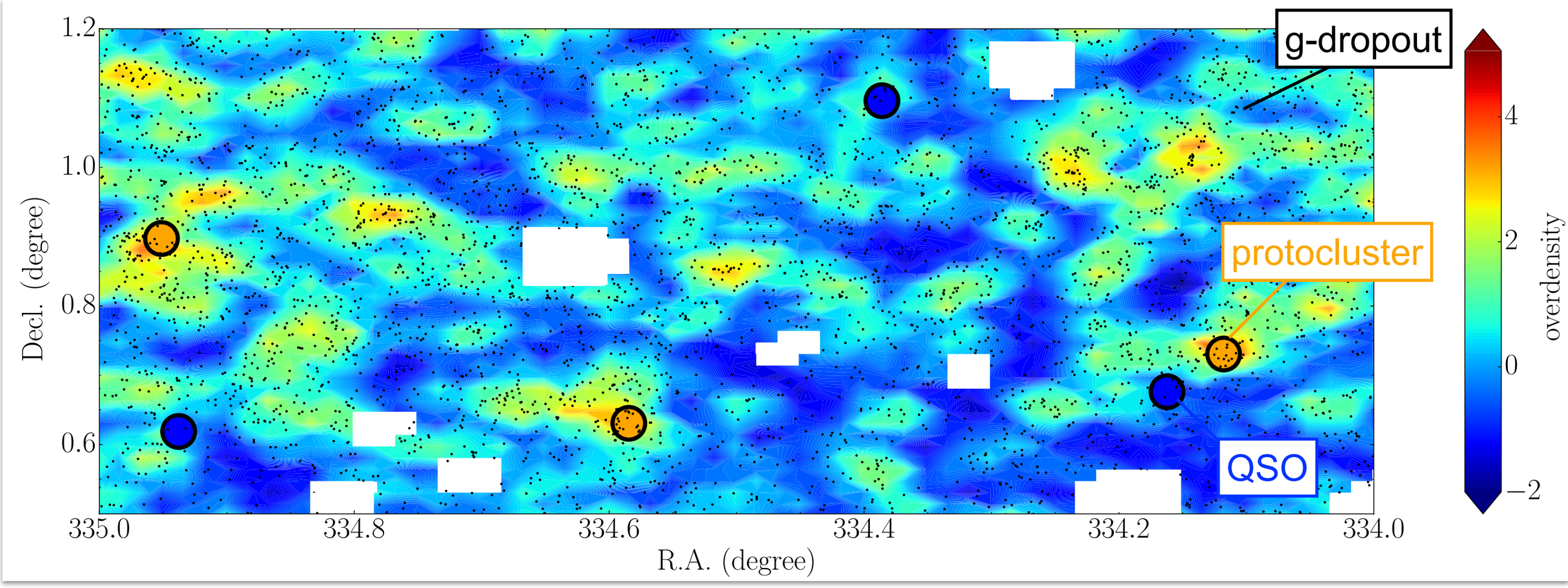
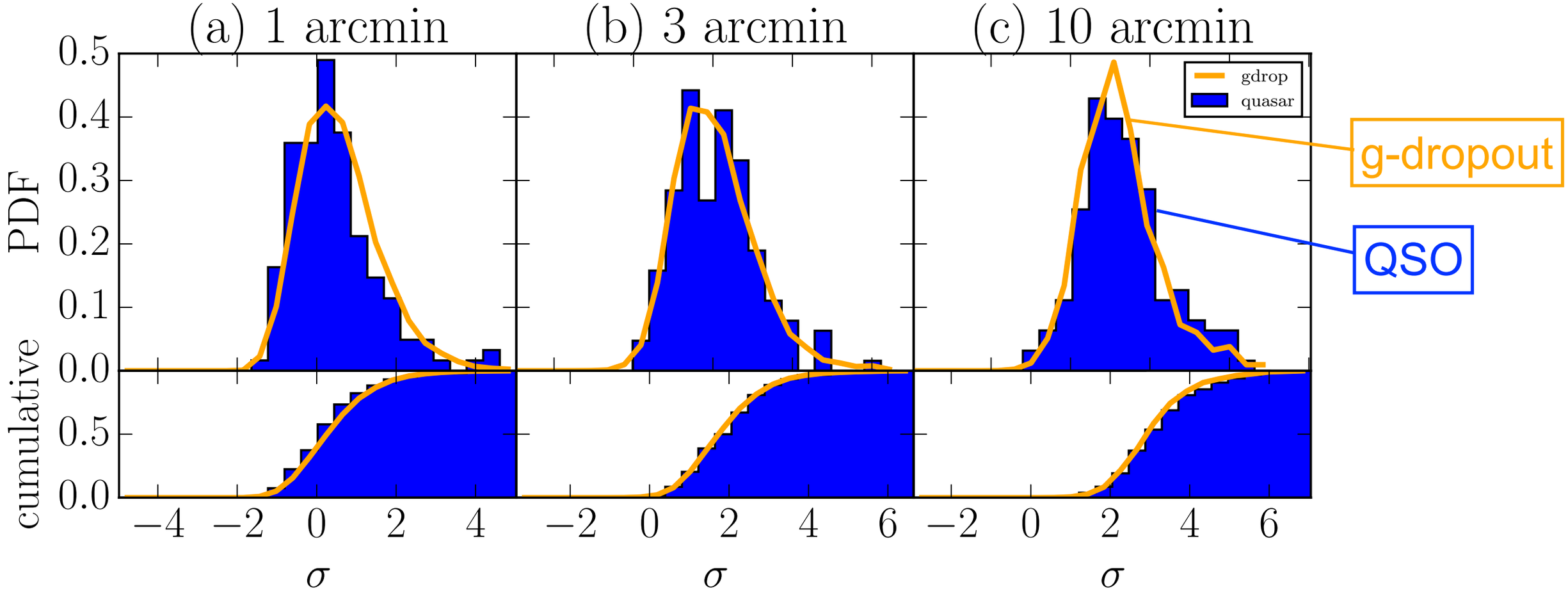


Distribution of the local max of overdensity significances within 1, 3, 10 arcmin radius centered on QSOs

Probability density function of the local max of overdensity significances within 1, 3, 10 arcmin radius centered on QSO/g-dropouts



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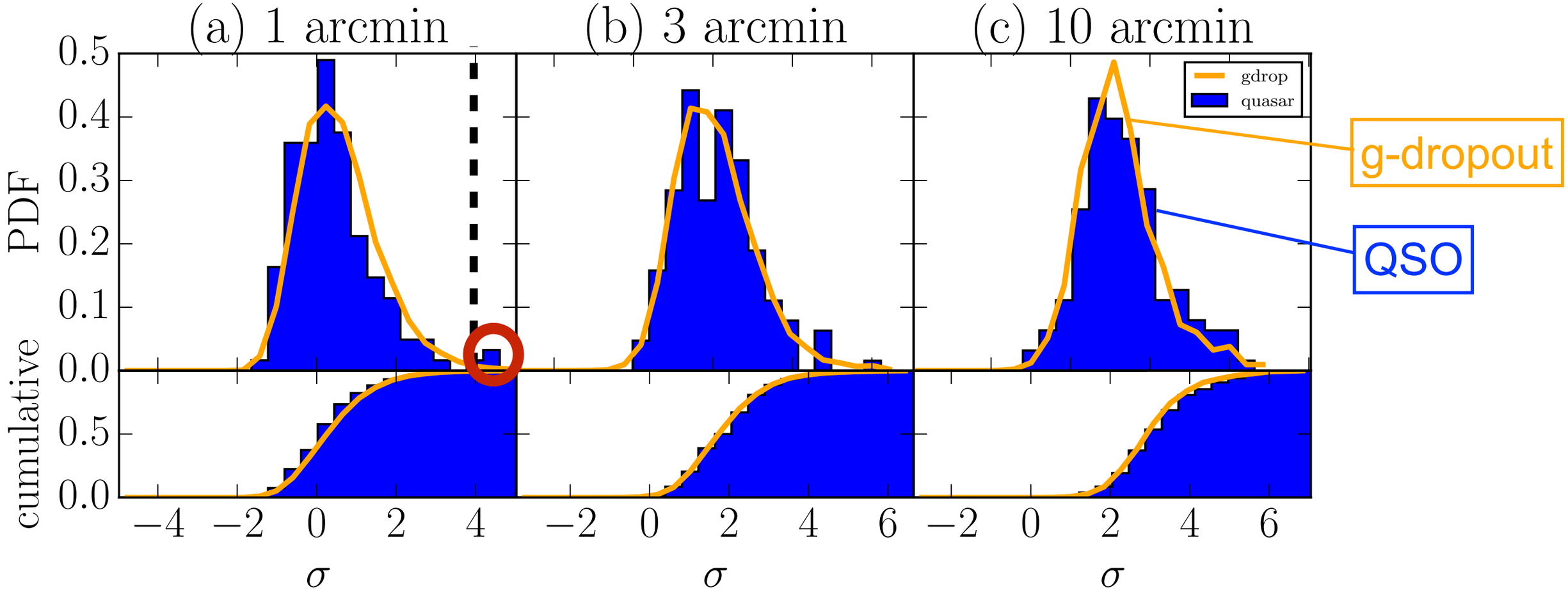

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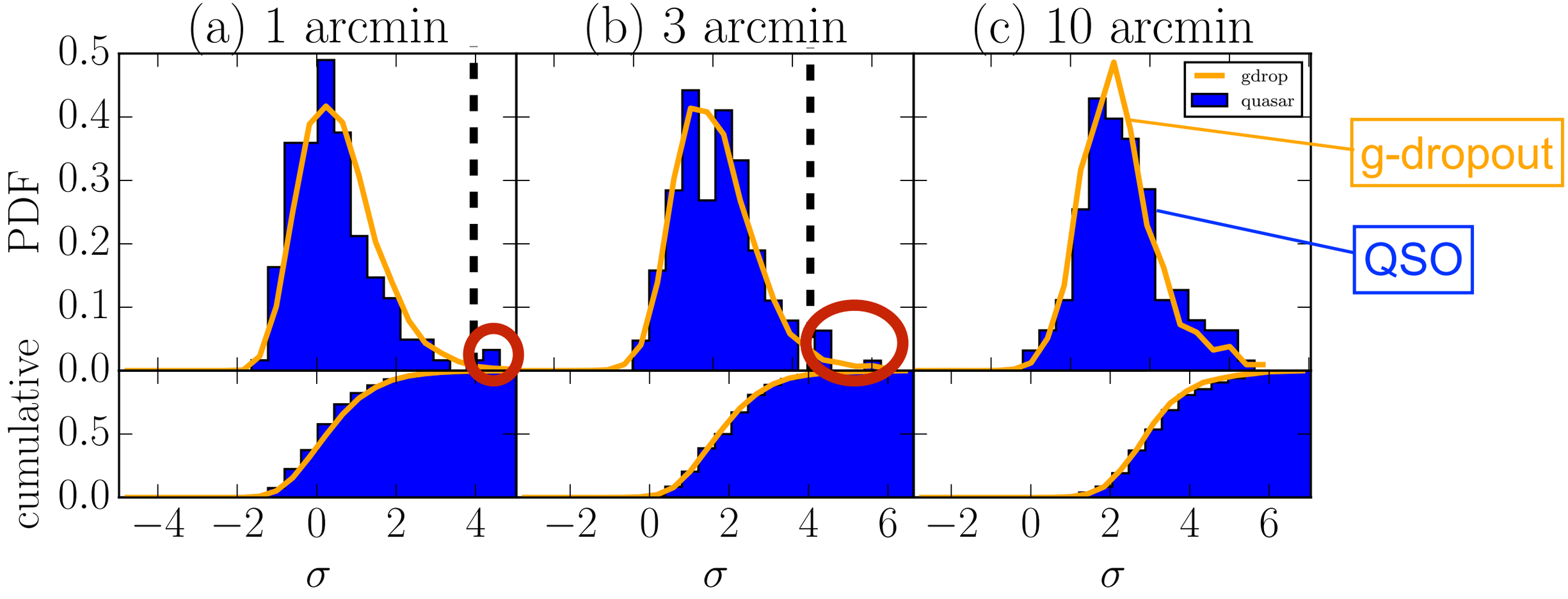

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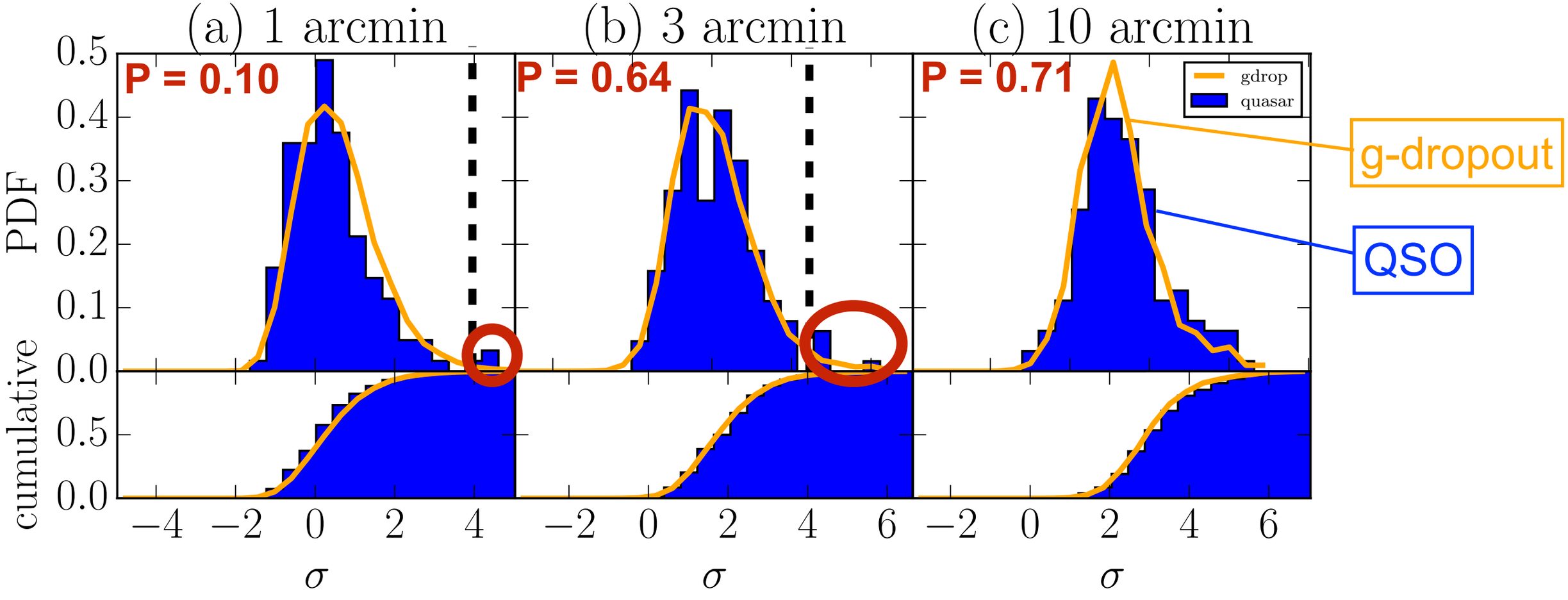

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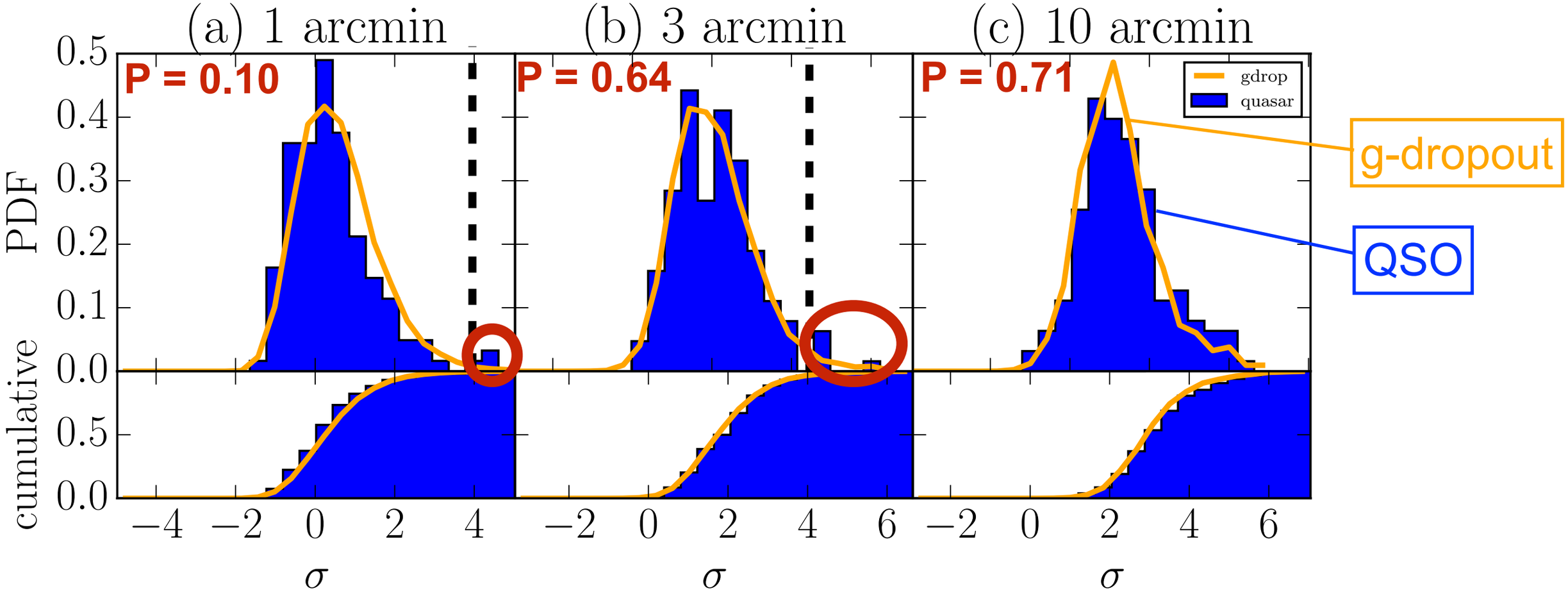

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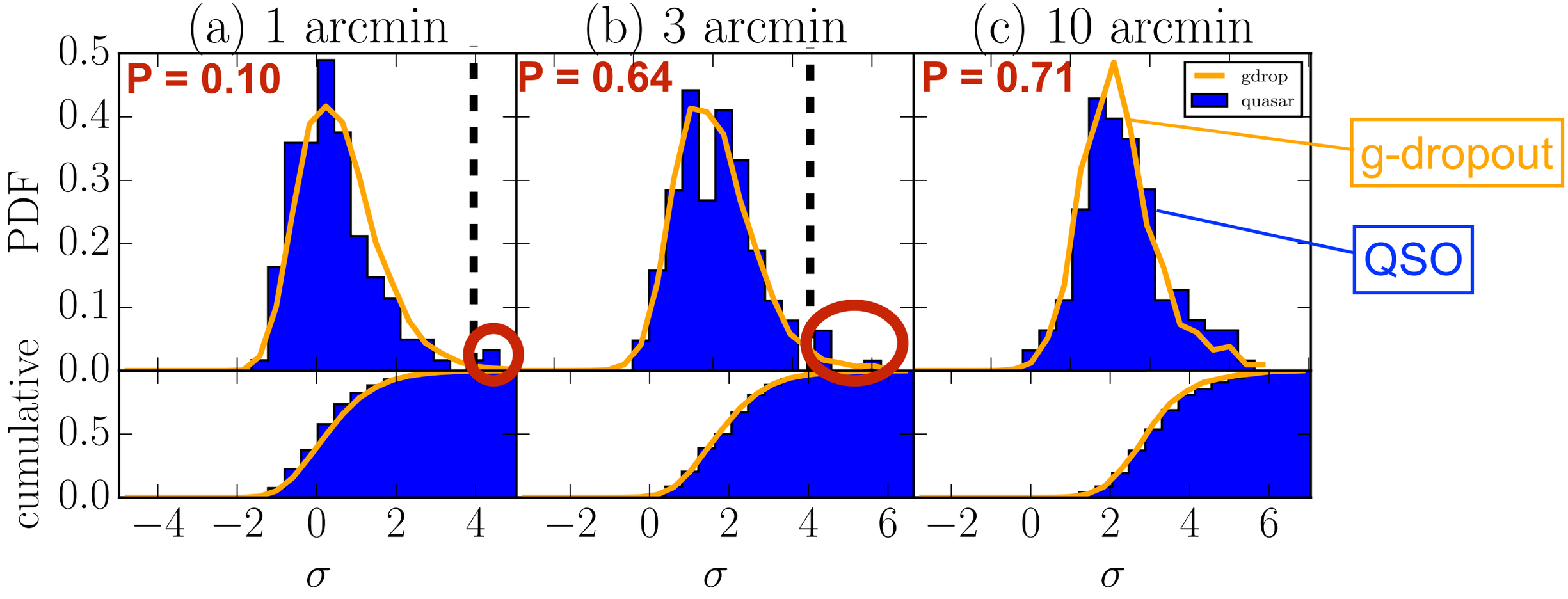

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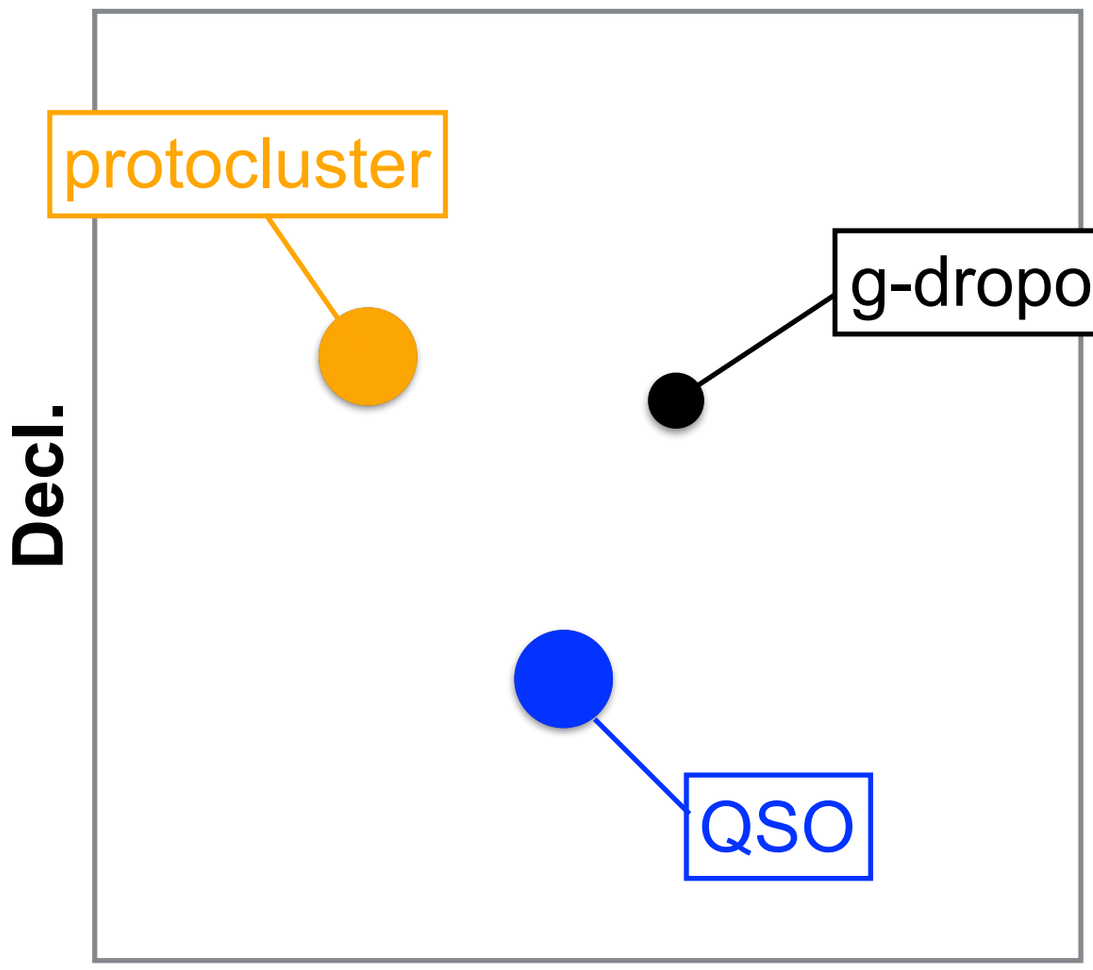
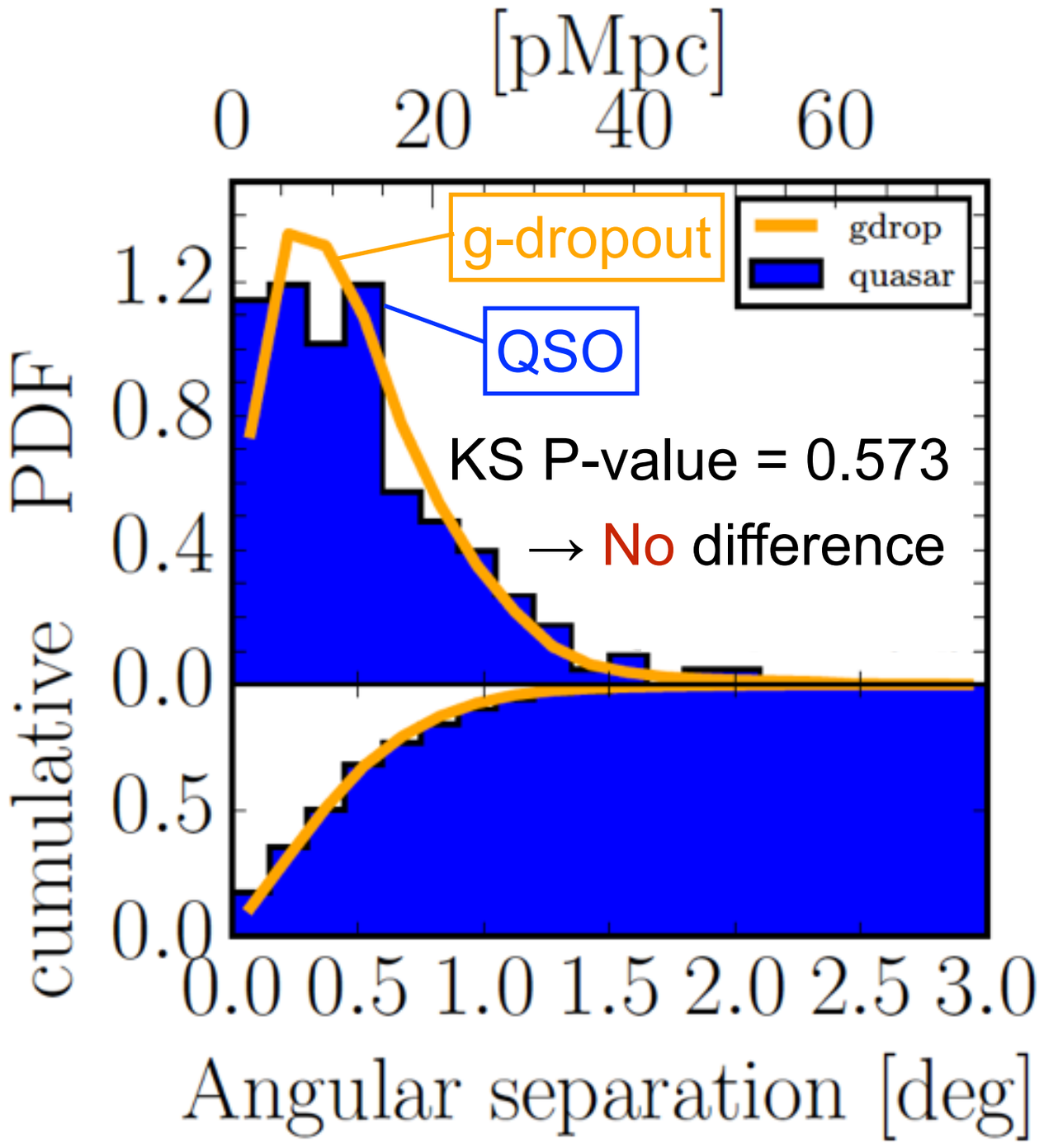
→ QSOs reside in almost same environment as g-dropouts

Distribution of separations from QSOs to the nearest protoclusters





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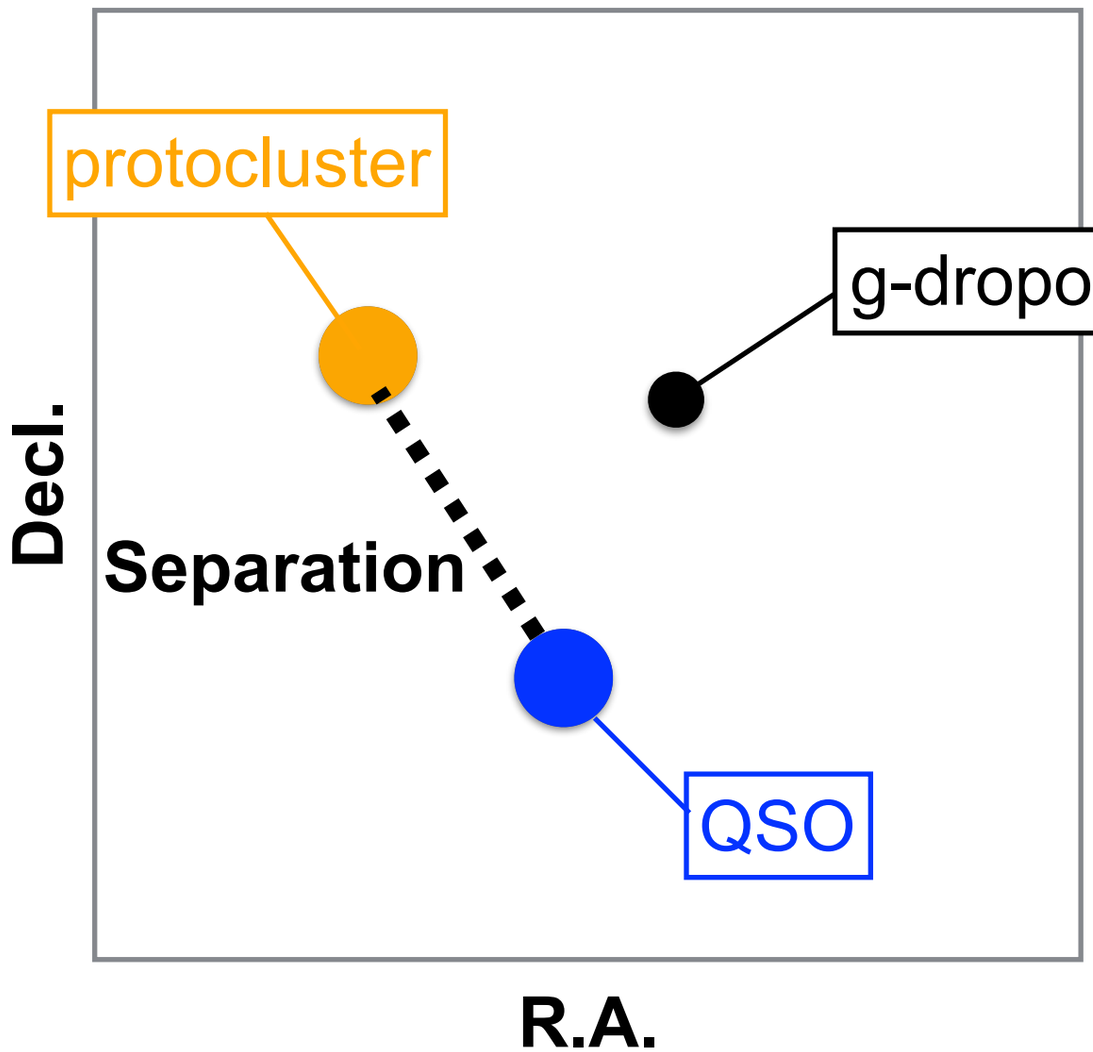

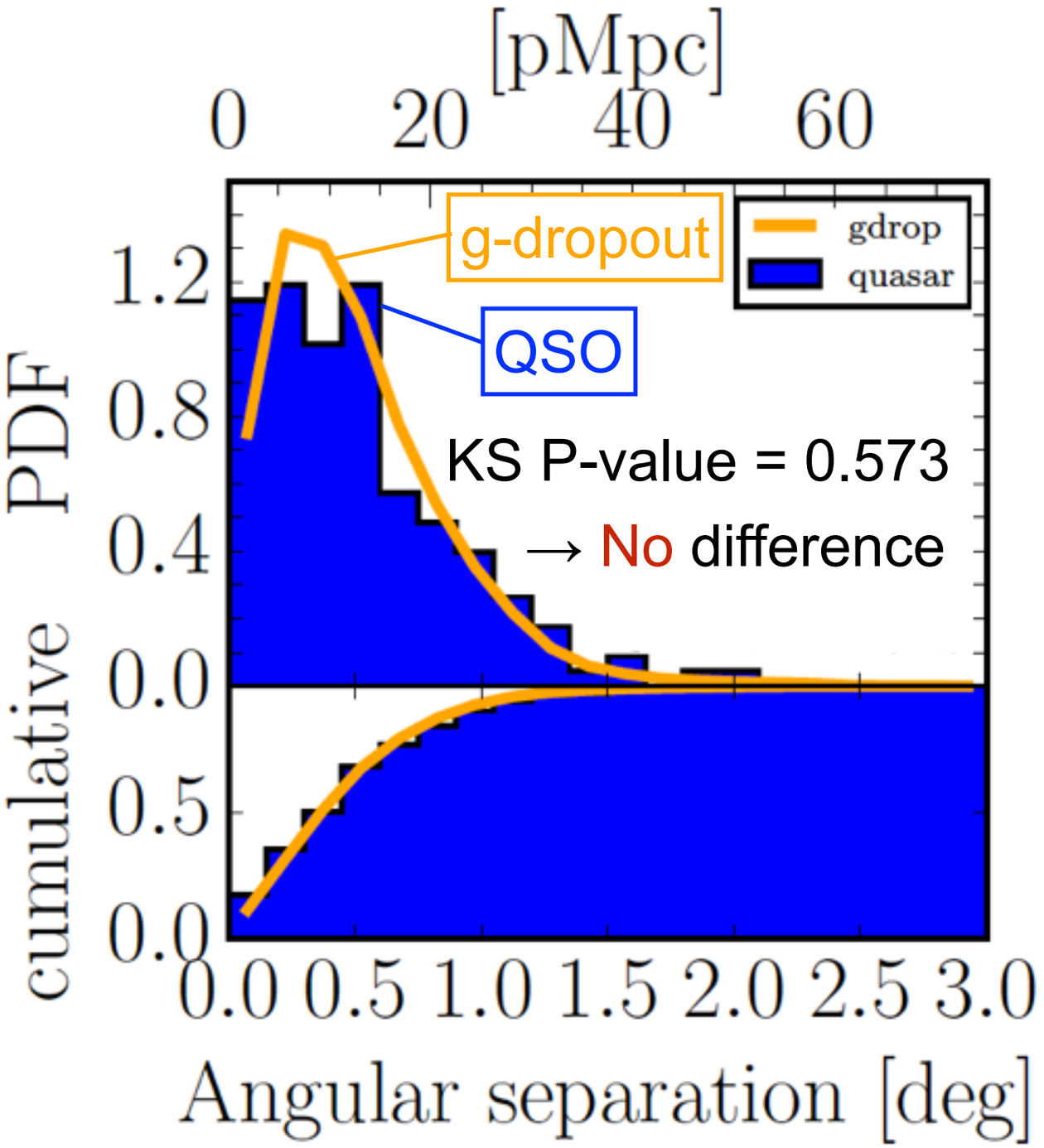

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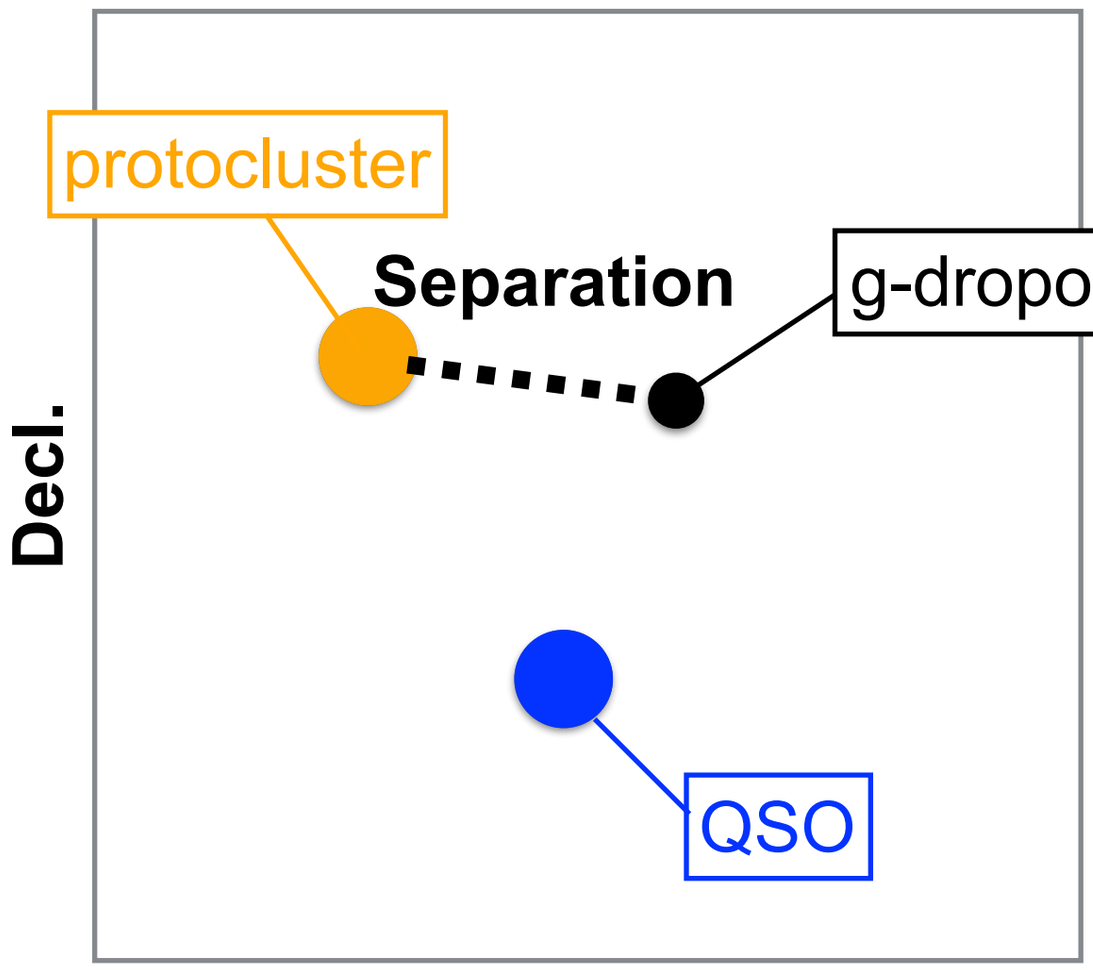

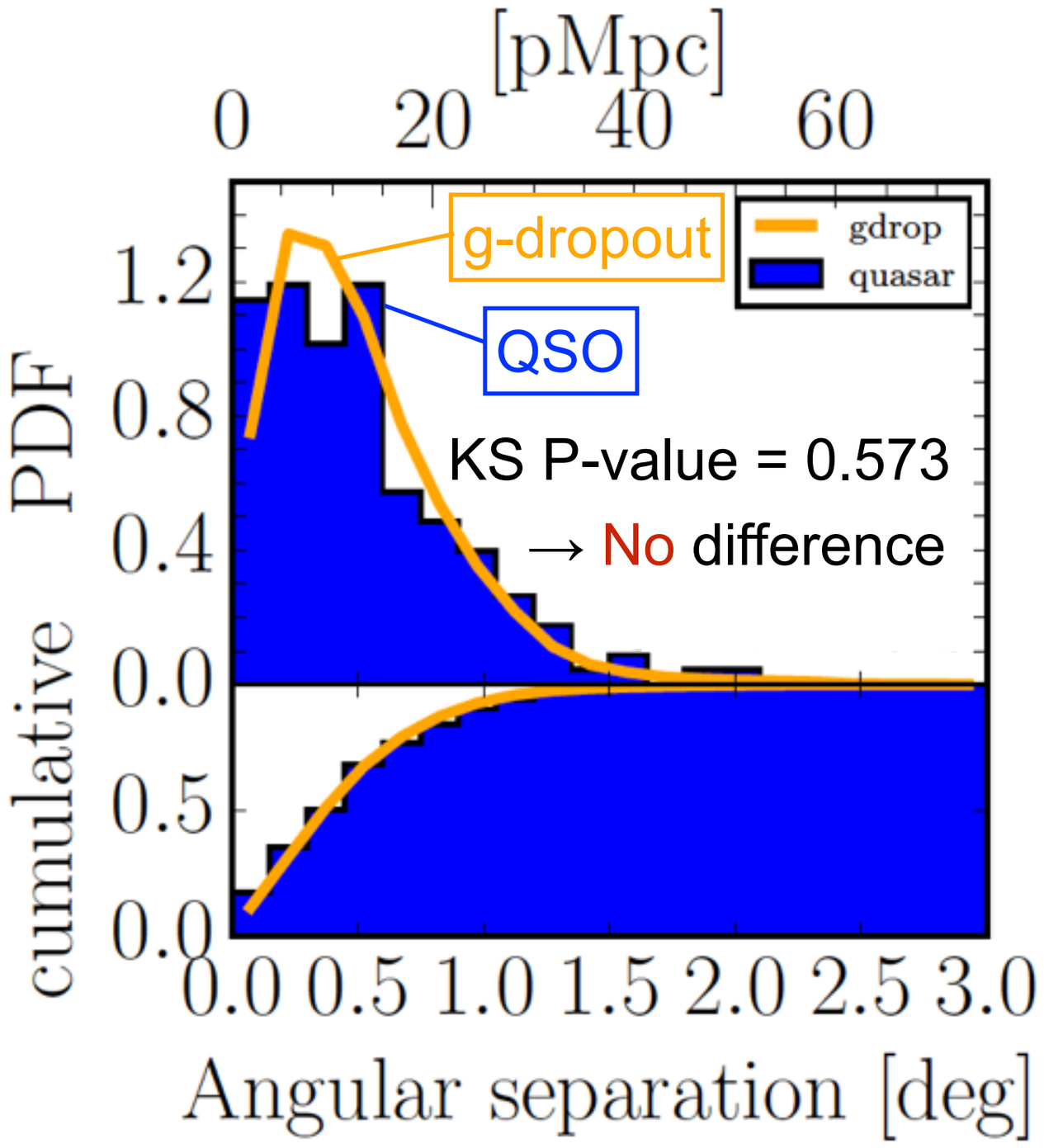

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Short summary

We present the cross-correlation between 151 luminous QSOs and 179 protocluster candidates at z~4 from Wide imaging survey (~121 deg^2) performed with a part of HSC-SSP.

(1) Only 2 SDSS QSOs out of 151 exist in the protocluster region

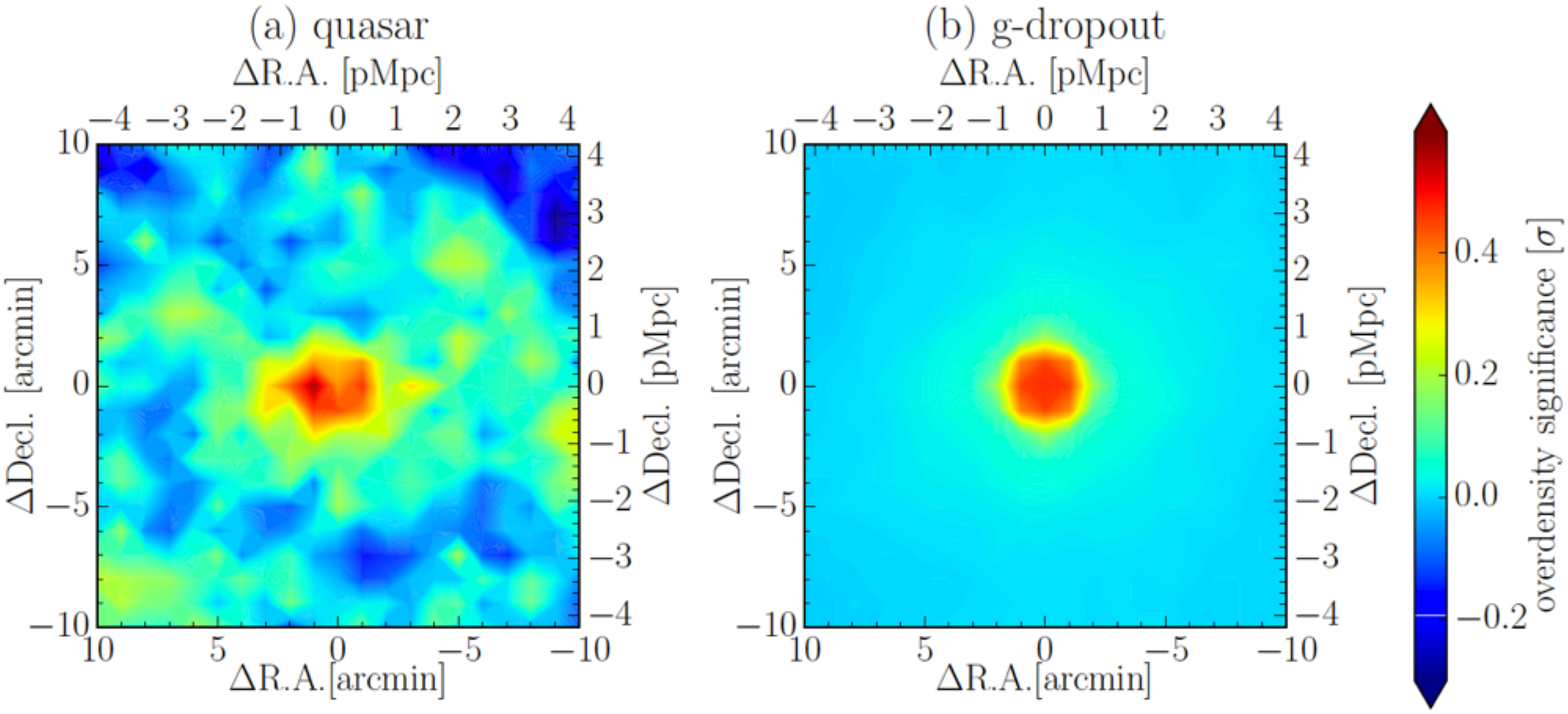
(2) Overdensity significance at the QSO position is identical to that of SFGs

(3) Distance distribution to the nearest overdense region is also the same

→ **QSOs tend to reside in almost the same environment as SFGs**

→ **inconsistent with Merger scenario rather secular process**

Median stacking density map around quasars



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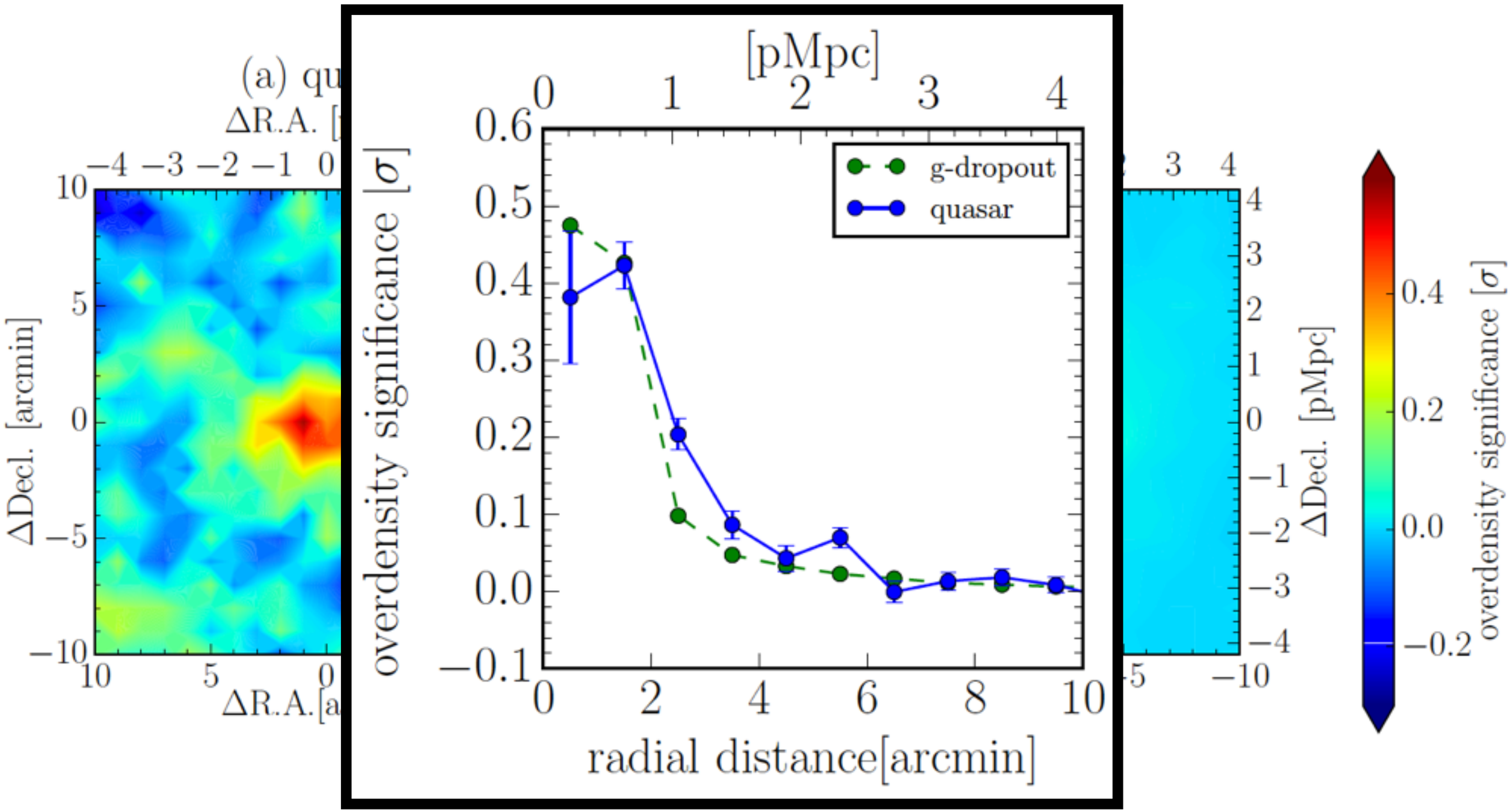

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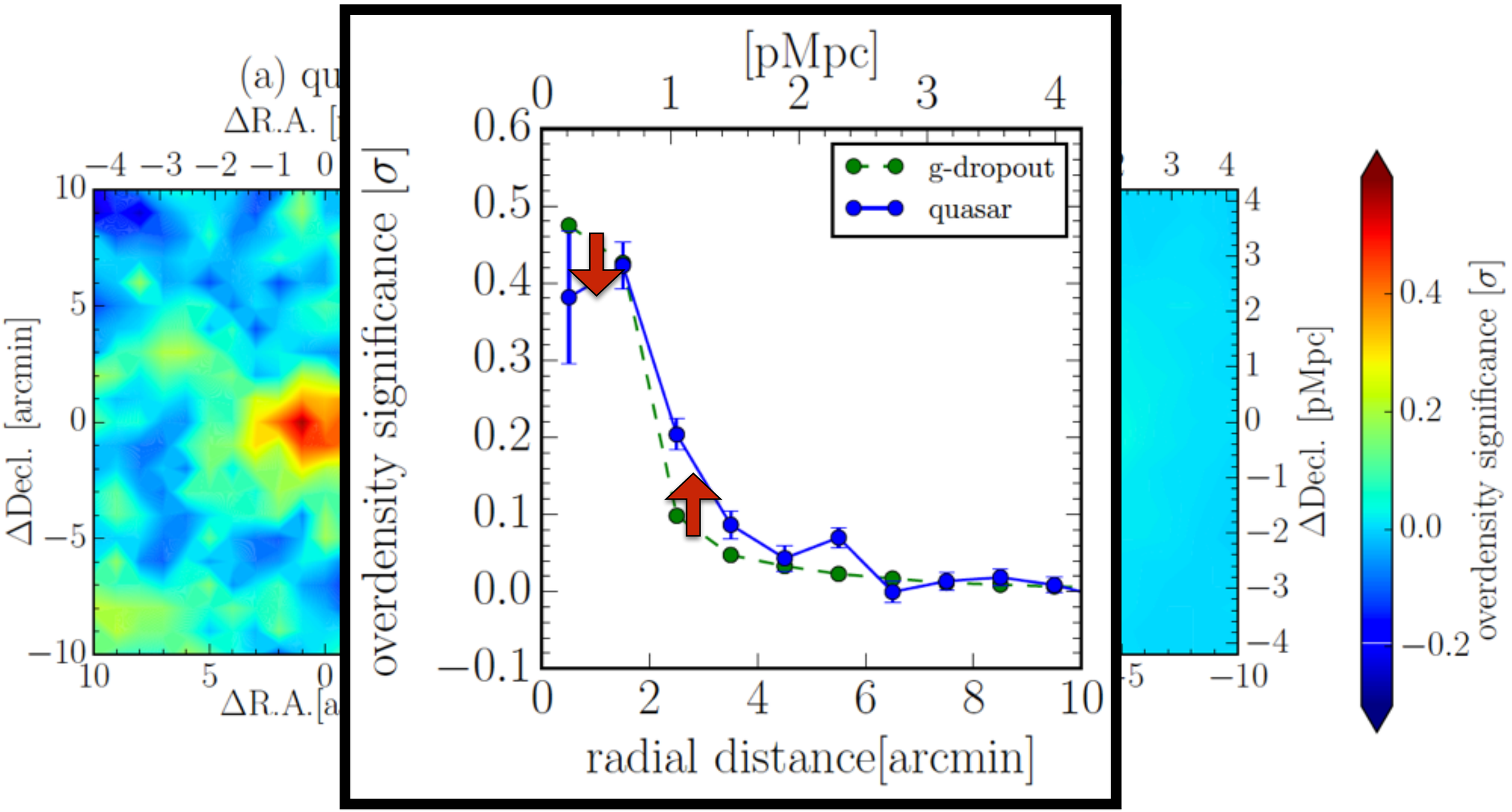
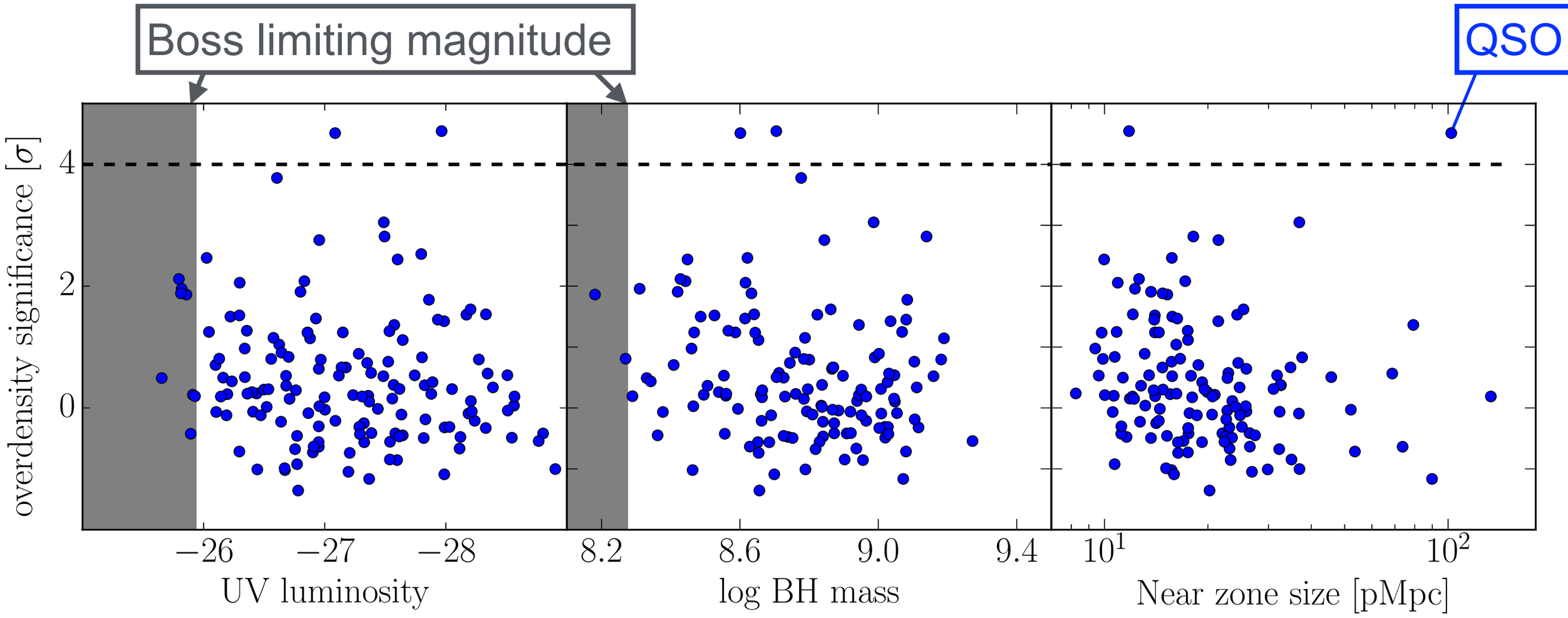


The average density around quasars is slightly higher at 1.0-2.5 pMpc while, lower at < 0.5 pMpc

Rest-UV, black hole mass, and near zone size in overdense regions



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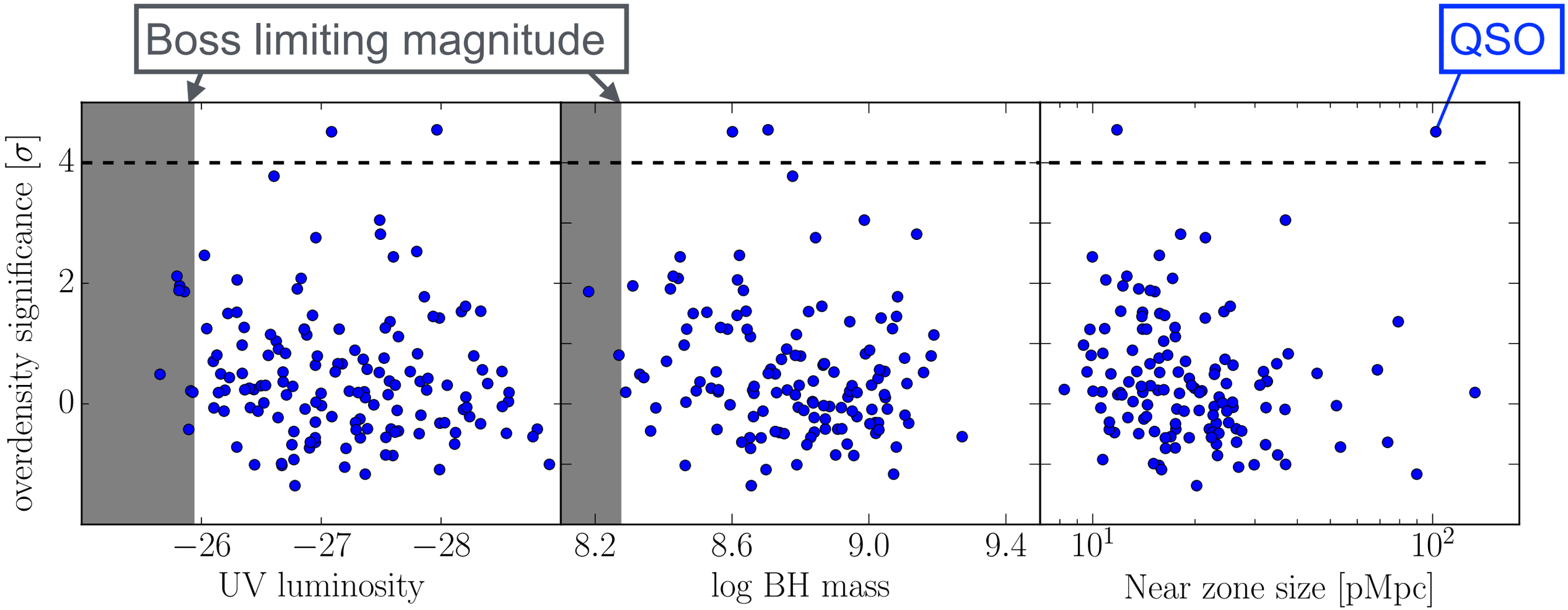

(1) almost no correlation between overdensity and photometric property of QSO

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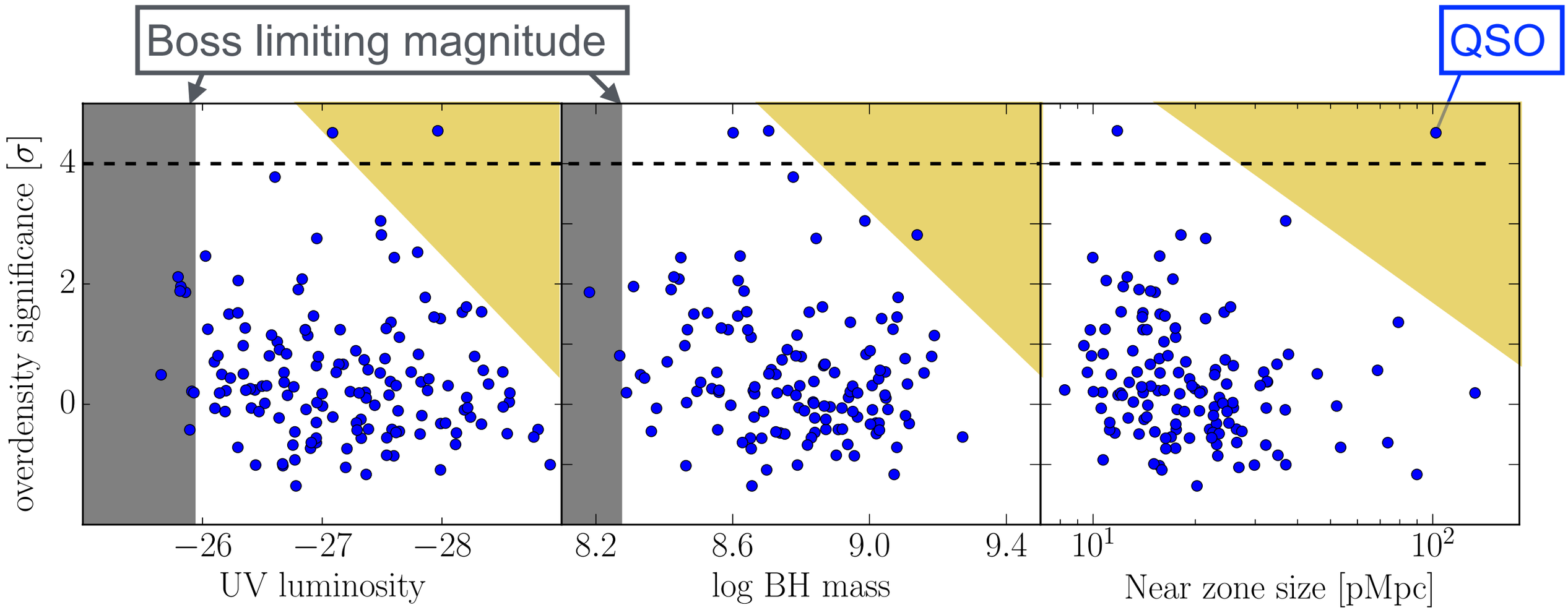

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(2) but …

QSOs with higher UV/more massive BH tend to avoid the most overdensities

QSO near zone sizes are anti-correlated with overdensity

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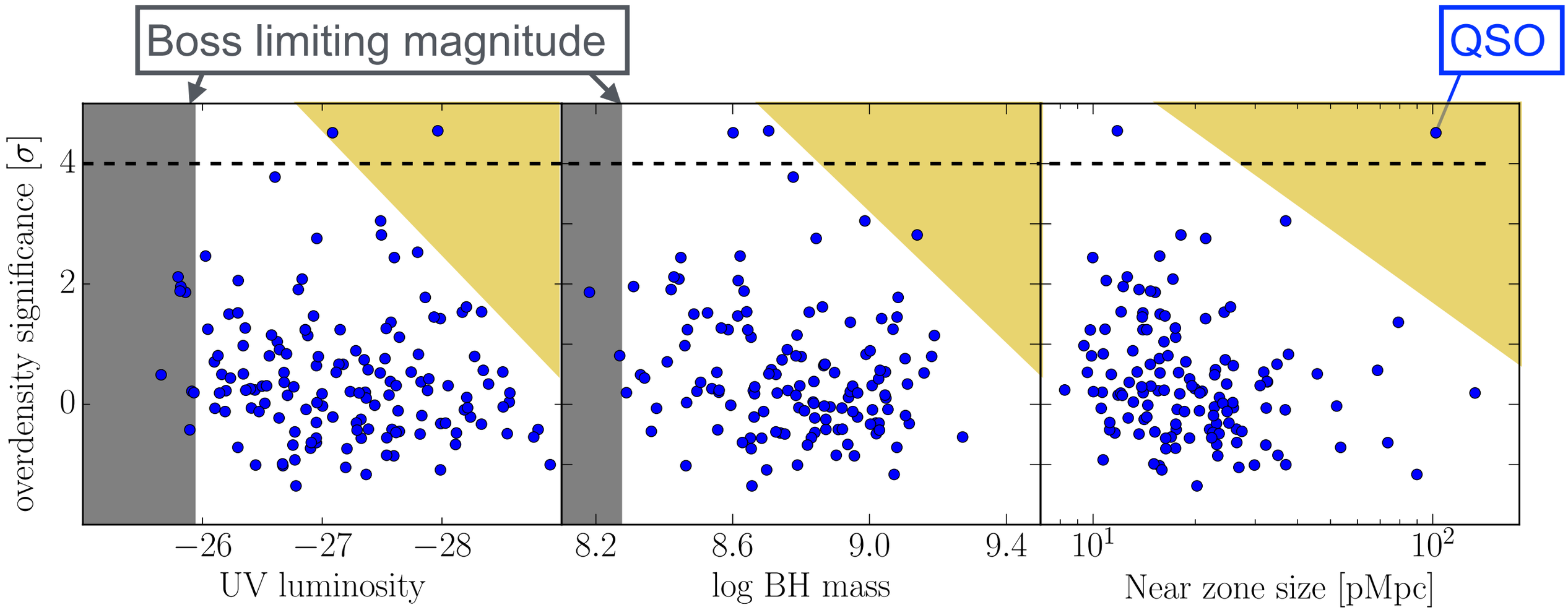

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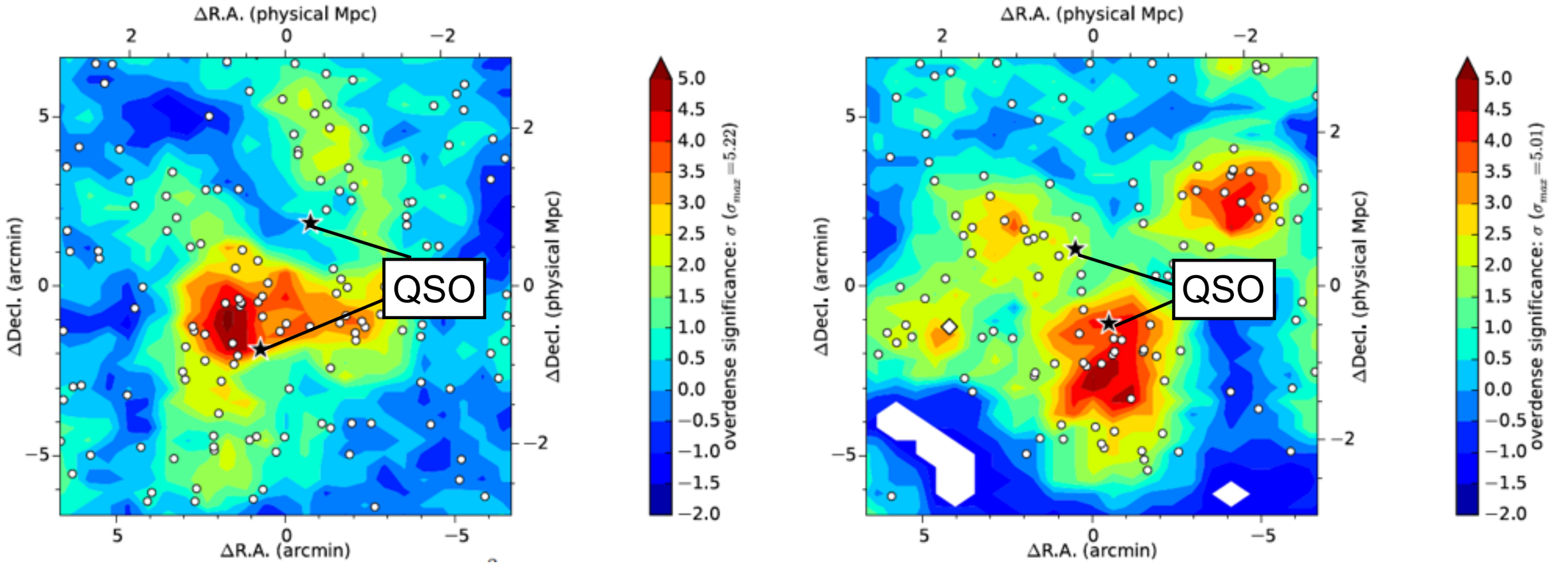
luminous QSOs might suppress star formation in their close vicinity

Environment around QSO Pair (Onoue et al. 2017)

(1) the same HSC data and the method to measure overdensity

→ 2 luminous quasar pairs at z~3-4



QSO pairs reside in overdense regions with ~4.5 σ (not richest)

→ even a quasar pair cannot emerge in the most massive haloes

(2) QSO pair tends to occur in massive halos (not the most massive) at z~0.3-1.5

→ QSO pairs tend to reside in overdense regions unlike single QSOs

Summary

We present the cross-correlation between 151 luminous QSOs and 179 protocluster candidates at z~4 from Wide imaging survey (~121 deg^2) performed with a part of HSC-SSP.

(1) Only 2 SDSS QSOs out of 151 exist in the protocluster region

(2) Overdensity significance at the QSO position is identical to that of SFGs

(3) Distance distribution to the nearest overdense region is also the same

→ **QSOs tend to reside in almost the same environment as SFGs**

→ **may be inconsistent with Merger scenario**

(4) brighter QSOs tend to reside in lower dense regions

→ **luminous QSOs may be suppressing SF in their close vicinity**

(5) QSO pairs reside in overdense regions

→ **QSO pairs tend to reside in overdense regions unlike single QSOs**